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by Serdar Kabaca

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by

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## Abstract

This paper contributes to the literature by documenting labour income share fluctuations in emerging-market economies and proposing an explanation for them. Time-series data indicate that emerging markets differ from developed markets in terms of changes in the labour share over the business cycle. Labour share is more volatile in emerging markets and is procyclical, especially in countries facing countercyclical interest rates. In contrast, labour share in developed markets is more stable and slightly countercyclical. A frictionless small open-economy real business cycle model cannot account for these facts. I introduce working capital into this model, which generates liquidity need for labour payments. The main result is that the behaviour of the cost of borrowing can predict the right sign of the co-movement between labour share and output in both country groups, and can partly be responsible for the volatility of labour share. I also show that imperfect financial markets in the form of credit restrictions not only amplify the results for the variability of labour share but also help better explain some of the striking business cycle regularities in emerging markets, such as highly volatile consumption, strongly procyclical investment and countercyclical net exports.



*JEL classification: E25, F41, E44*
*Bank classification: Business fluctuations and cycles; Labour markets; Development economics; International topics; Interest rates*



## Résumé

Cette étude vient enrichir le corpus de recherche, l'auteur y mettant en évidence les variations de la part du travail dans le revenu des facteurs de production (la « part du travail ») au sein des économies émergentes et avançant une explication de cette variabilité. Les séries chronologiques montrent qu'à cet égard, les marchés émergents et les économies avancées ne connaissent pas les mêmes variations au cours du cycle économique. La part du travail est sujette à une plus forte volatilité dans les marchés émergents et est procyclique, surtout dans les pays où les taux d'intérêt revêtent un caractère contracyclique. Dans les économies développées en revanche, cette part offre une meilleure stabilité et est légèrement contracyclique. Un modèle de cycle réel sans friction adapté à une petite économie ouverte ne peut rendre compte de ces caractéristiques. L'auteur y ajoute donc une composante « fonds de roulement », qui engendre un besoin de liquidités pour le versement des salaires. Le principal résultat de l'étude est que l'évolution des coûts d'emprunt permet de prédire avec justesse si la covariation de la part du travail et de la production est positive ou négative dans les deux groupes de pays, et peut en partie expliquer la volatilité inhérente à la part du travail. L'auteur démontre également que l'imperfection des marchés des capitaux introduite sous forme de resserrement du crédit non seulement amplifie les résultats obtenus quant à la variabilité de la part du travail, mais aide aussi à mieux comprendre certaines des régularités remarquables du cycle économique dans les marchés émergents, comme la

forte volatilité de la consommation, la procyclicité marquée des investissements et le caractère contracyclique des exportations nettes.

*Classification JEL : E25, F41, E44*
*Classification de la Banque : Cycles et fluctuations économiques; Marchés du travail; Économie du développement; Questions internationales; Taux d'intérêt*

# 1 Introduction

## 1.1 Motivation and Main Findings

Many economic models assume constant factor shares of income following the stylized facts of growth discussed by Kaldor (1961). Recently, researchers have been more interested in explaining short-run fluctuations and cyclical movements of labour (income) share. However, the literature has focused on developed markets, predominantly the United States, and is silent on labour share fluctuations in emerging markets. In this paper, I document the volatility and the cyclicality of labour share in emerging markets and show that there is a close relationship between labour share and the interest rate that these countries face in financial markets. I then build a model where wages have to be financed through working capital loans and show that variation in the cost of borrowing can account for the movements of the labour share over the cycle. The premise of the paper is that financing matters to labour share, and that emerging markets serve as a good natural experiment due to the financial problems and the different features of the interest rates that they face.

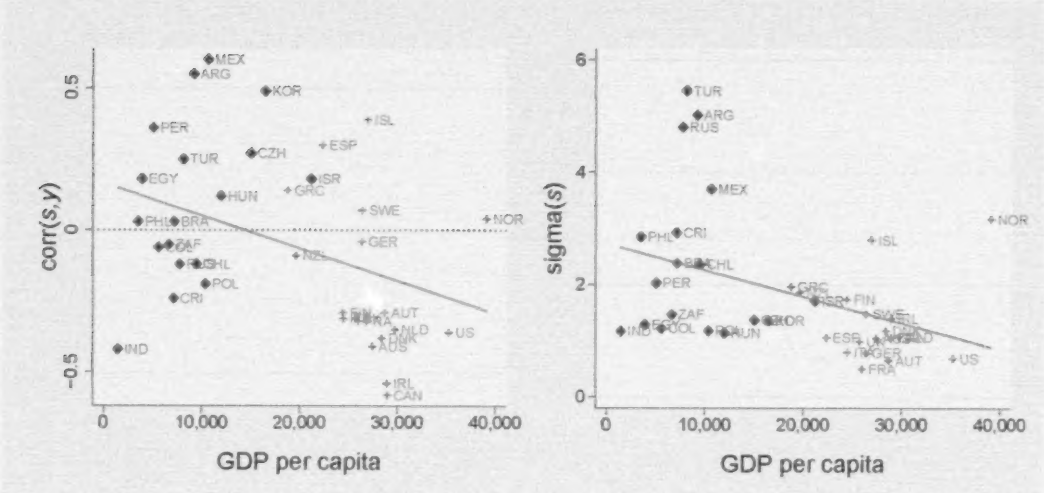
Figure 1 illustrates the characteristics of labour share fluctuations in both emerging and developed markets. Labour share tends to be procyclical with output in emerging markets, whereas it is slightly countercyclical in developed markets. In addition, labour share is much more volatile in low-income countries. However, there is a large variation across countries in terms of characteristics of labour share fluctuations. India, for instance, having the lowest income per capita in the sample, does not have a procyclical labour share. Yet Korea has a strongly procyclical one although it is one of the richest emerging economies. Figure 2, on the other hand, provides a clearer picture, showing that labour share is procyclical with output, especially in countries with countercyclical interest rates. Thus, a decrease in the cost of borrowing during booms is associated with a higher labour share in these economies. The more countercyclical are interest rates, the more procyclical is labour share.[1] Further, countries that face more volatile interest rates tend to have more volatile labour shares. Finally, these results are shown to be robust to adjustments of the labour share that control for self-employment and the informal sector.

Motivated by these observations, this paper concentrates on financial links to understand the dynamics of labour share in different country groups, and develops a model in which the variation in borrowing opportunities generates movements in the labour share through working capital mechanisms. The model generates labour share movements over the cycle even with a Cobb-Douglas production function, when firms have to borrow in order to pay workers before production takes place and sales are cashed out.[2] Even if the firm does

[1]The negative slope coefficients in Figure 1 disappear when the fluctuations in the interest rate are taken into account. Therefore, when the movement of the interest rate is considered, income level becomes insignificant to explain the differences in labour share fluctuations.

[2]Barth III and Ramey (2002) discuss a data set for U.S. firms and show that working capital, including

Figure 1: Labour Share Fluctuations across Income Level



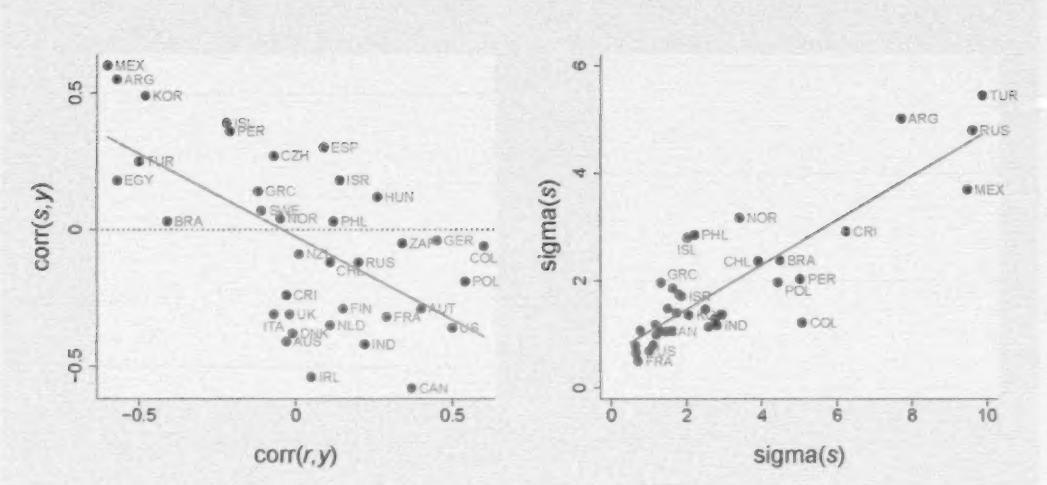

Notes: corr($s$,$y$) and sigma($s$) denote the correlation of labour share with output and the standard deviation of labour share, respectively. The data are annual and cover the period 1981-2008 for most countries. Both output and labour share are HP-filtered using the smoothing parameter, 6.25. GDP per capita on the x-axis (purchasing-power-parity adjusted in U.S. dollars) in 2000 is taken for the income level. See Appendix A for data sources.

internal financing, labour decisions would still be affected, since this creates an opportunity cost in a world with a positive return on bonds. The liquidity need to finance the wage bill makes labour demand sensitive to interest rate changes. The duration between the time when wages are paid and the time when the goods market clears imposes an extra cost on the wage bill, namely interest payments. During a recession, the share of output that goes to capital, including these interest payments, increases due to higher interest rates, which lower the labour share of output. The introduction of limits on borrowing capacity generates an effective interest rate that is more responsive than the observed one, and leads to a larger response in the labour share.

In the quantitative analysis section, the model is calibrated to Mexico. The main findings show that working capital mechanisms can generate the right co-movement of labour share with output, as well as explain part of the volatility in labour share. In addition to this effect, the results are amplified when the agents are credit constrained. The presence of the binding leverage constraint not only amplifies the response of labour share but also improves the performance of the model with respect to other business cycle regularities in emerging markets, particularly highly procyclical investment and countercyclical net exports.

the value of inventories and trade receivables, is 17 months of final sales, on average, over the period 1959 to 2000. For emerging-market economies, Fan et al. (2012) emphasize the importance of short-term credit.

Figure 2: Labour Share vs. Interest Rate Fluctuations




Notes: corr$(s,y)$ and sigma$(s)$ denote the correlation of labour share with output and the standard deviation of labour share, respectively. $r$ denotes real, annualized and short-term interest rates in those countries. The data are annual and cover the period 1981-2008 for most countries. Both labour shares and interest rates are HP-filtered using the smoothing parameter, 6.25. See Appendix A for data sources.

The model presented in this paper can also explain the different movements of labour shares across emerging and developed markets. Particularly, the model can generate a relatively stable and countercyclical labour share for developed markets due to the different behaviour of their interest rates. However, it can only account for one-fifth of the variations in labour share in a developed market such as Canada. Several recent papers have shown the importance of adjustment costs such as searching, hiring and firing costs on the dynamics of labour markets in developed economies.[3] Following these papers, the model is extended with a convex adjustment cost that firms face when they adjust their labour input. The idea is to explore how much these types of frictions contribute to the cyclicality of labour share over and above the financial channel. The result is that labour adjustment costs can explain labour share movements in developed markets more than the financial channel. On the other hand, when the same model is calibrated to emerging markets, the financial channel contributes more to labour share fluctuations in these economies through the volatile cost of borrowing.

[3]See Boldrin and Horvath (1995), Bentolila and Saint-Paul (1998), Choi and Rios-Rull (2009), Rios-Rull and Santaeulalia-Llopis (2010) for the dynamics of labour share in developed markets.

## 1.2 Related Literature

This paper is related to the literature that previously studied the countercyclical behaviour of interest rates that emerging markets face. Neumeyer and Perri (2005) and Uribe and Yue (2006) show that countercyclical interest rates can propagate business cycle fluctuations in this group of countries. However, they do not focus on the implications for labour income. Recently, Li (2011) showed that these models, along with the income effect on labour supply, can explain a significant part of the wage volatility.[4] Here, I first show that these models with a working capital requirement move the labour share over the cycle. Second, I show that the perfect-credit environment used in these models is not substantial enough to match fluctuations in emerging markets. This motivates an emphasis on imperfect credit along with working capital requirements.

In terms of the macroeconomic implications of credit frictions, there are numerous studies in the literature following Kiyotaki and Moore (1997) and Bernanke et al. (1999).[5] These studies highlight the importance of credit frictions in the fluctuations of developed markets. Credit frictions exist in developing countries as well, especially when their relatively low level of financial development is considered. Calvo (1998) and Caballero and Krishnamurthy (2001), in fact, study the effects of financial frictions on output drops in emerging markets. Recently, Mendoza (2010) showed that the real cost of borrowing can be amplified in sudden stops through credit frictions. This paper contributes to this literature by introducing a working capital mechanism and a varying credit standard over the cycle, and shows that the volatile cost of borrowing – whether the observed one in the market or the effective one through imperfect credit – explains the short-run dynamics of labour share.[6]

The rest of the paper is organized as follows. Section 2 documents the volatility and correlation statistics for the labour share in both emerging and developed markets, and shows that the results are robust to different measures of, and adjustments on, labour share. Section 3 presents the model with a working capital requirement under both perfect and imperfect credit. Section 4 describes the calibration strategy. Section 5 discusses the main findings of the model and performs sensitivity analyses to parameter changes. Section 6 extends the model with an adjustment cost on labour decisions and compares the results across emerging and developed economies. Section 7 concludes.

[4]During the completion of this work, I have learned that Li's latest version of the paper uses the spot labour market rather than contractual market as in earlier versions, which makes the model similar to the one presented here. However, she does not consider the effect of imperfect credit in these economies.

[5]See Kocherlakota (2000), Aiyagari and Gertler (1999), Devereux and Yetman (2009), Jermann and Quadrini (2006) for the use of financial constraints.

[6]By imperfect credit, I consider not only credit rationing but also leverage cycles explained by various types of asymmetric informational frictions in the emerging-market assets, as in Fostel and Geanakoplos (2008).

# 2 Labour Share and Interest Rate Movements

## 2.1 The Measure of Labour Share

Labour share is computed using the total compensation of employees from GDP income accounts. In the income approach, gross value-added GDP is the sum of labour compensation, capital income (corporate profits, interest income, rental income and depreciation), mixed income of the self-employed (unincorporated income), and indirect taxes less subsidies. Most countries officially publish the total compensation of employees, indirect taxes and the rest as operating surplus. Therefore, the labour share is measured as follows (see Gollin, 2002):

$$\text{Labour Share} = \frac{\text{Labour Compensation}}{\text{GDP-net indirect taxes}}. \tag{1}$$

Since we are interested in the incomes earned by the factors of production, government income is excluded from the gross value-added. In doing so, I assume that net indirect taxes go to both capital and labour income. In section 2.4, I adjust this measure of labour share by using proxies for the labour income of the self-employed. In section 2.5, I discuss sectoral labour share and the contribution of the informal sector to the regularities of labour share movements over the business cycle. These analyses show that the cyclical properties of labour share using the above formula are robust to adjustments on labour share.

## 2.2 Data

I choose countries that report income accounts compiled with the 1993 System of National Accounts. Income accounts data have an annual frequency and come from the Organisation for Economic Co-operation and Development (OECD) and the United Nations (UN).[7] I include countries that have at least 10 annual observations, to make sure that each country has recessions and expansions over the sample period. This leaves us with 18 emerging-market economies. These economies cover most of the countries defined as emerging markets by institutions providing investment analysis.[8,9] In addition to emerging markets, 18 developed markets are included in the sample for comparison. These countries are listed in Appendix A. Data for most of the emerging economies start at 1981, so I use labour share data for developed countries starting at 1981 as well.

For real interest rates, I use short-term domestic rates from the International Financial

[7]The OECD has longer labour compensation data for some developed countries, as well as Mexico and Turkey. I check that the OECD data are consistent with the data reported to the UN. Therefore, I choose the longer data set from the OECD for these countries.

[8]Korea has recently been classified as a developed market in these institutions. However, during our sample period, 1980-2008, the country was mostly in the category of emerging markets, in that the GDP per capita in Korea was below $20,000 until 2004.

[9]I also include Costa Rica, given its relatively high per capita income and long time-series data, although it is not listed as an emerging market in FTSE or MSCI lists.

Statistics (IFS). They represent mostly the cost of funds in the interbank market.[10] The GDP deflator is used to obtain the ex-post real interest rate for each economy. For developed economies, short-term interest rates come from OECD financial indicators. These are either interbank rates or treasury bill rates with a maturity of three months. Details are reported by country in Appendix A.

I also have the data set from Uribe and Yue (2006) on international interest rates that emerging markets face. They construct interest rates for each country using their corresponding JP Morgan EMBI+ spreads over U.S. treasury bills. Since these bonds are denominated in U.S. dollars, real yields are calculated using a proxy for the expected inflation in the United States, which is equal to the average of the current and three preceding periods of annual inflation in the United States, based on the GDP deflator.[11] A drawback of using these interest rates is the limited coverage over the sample period. For some economies, EMBI data are not available. For others, the data start at either 1994Q1 or 1999Q3, which gives us a small number of observations at an annual level. Nevertheless, a robustness check is performed using these rates as well.

### 2.3 Stylized Facts

Tables 1 and 2 report the descriptive statistics of annual labour share fluctuations for emerging and developed markets, respectively.[12] $P$-values are provided in parentheses for the correlation coefficients. These statistics show that labour share, on average, is almost twice as volatile in emerging markets as in developed markets. More importantly, comovements of labour share with output differ in emerging markets compared to developed ones. The average correlation between the cyclical component of labour share and output tends to be positive (0.10) in emerging markets, whereas it is negative (-0.19) in developed markets. Since there is variation among countries in each group, I test a null hypothesis of no difference in these correlations across different country groups, and find a $t$-statistic of 3.08, indicating a rejection of the equal correlation at the 1% significance level. This indicates that labour share fluctuations are statistically different in emerging economies than in developed ones.

Furthermore, Table 1 shows that the average procyclical labour share is mostly driven by countries with countercyclical interest rates. When we consider the countries that have a

[10] Besides short-term money market rates, IFS data include lending rates to the private sector. However, these rates are not available for some countries and their description changes across countries significantly. Nevertheless, the main findings in this section do not change when these lending rates are used. The results can be obtained upon request.

[11] Using future inflation as expected inflation does not change the results much, since inflation is more or less stable in the United States over this period.

[12] I detrend the labour share, since it has fallen in the world in the past couple of decades (see Karabarbounis and Neiman, 2014). I use HP-filtering with the smoothing parameter, 6.25. Labour share is logged to capture the percentage deviations from the trend.

countercyclical cost of borrowing, i.e., Argentina, Brazil, the Czech Republic, Egypt, Korea, Mexico, Peru and Turkey, the average correlation of labour share with output goes up to 0.34 from 0.10. This implies a stronger procyclical labour share in these countries than the average in emerging markets. The other countries in the emerging-market group do not have significantly different movements in labour share than in developed markets.[13] The main result still remains if I use EMBI rates instead of domestic rates. Figure 3 shows that the procyclicality in labour share becomes more apparent as the country faces more strongly countercyclical EMBI rates.

For developed markets, we also observe a variation in labour share movements. Greece, Iceland and Sweden, which are likely to face countercyclical interest rates, also tend to have procyclical labour shares. In addition, I show in Kabaca (2013) that, during the recent euro crisis, labour share significantly dropped in countries such as Greece, Hungary, Iceland, Portugal and Spain. Not surprisingly, these are the countries facing higher risk premiums in recent years. Therefore, there appears to be a relationship between the dynamics of labour share and the risk component in the cost of borrowing, independent of development level.

The results from the within-country time-series analyses also support this relationship between labour share and the cost of borrowing. Figure 4 shows that in Mexico, where the official data on labour share go back to the 1970s, the volatility and procyclicality of labour share are quite apparent in the 1980s and 1990s. These periods are associated with a highly unstable financial environment and highly volatile capital flows in and out of the country. The co-movement of labour share and output disappears when the economy stabilizes after 2001; so does the relationship between interest rates and output. In addition, we do not observe the procyclical labour share in Mexico in the 1970s when there is less financial liberalization. The results are similar in Korea. During the period between 1970 and 2000, in which interest rates move negatively with output, labour share tends to be volatile and procyclical with output. After 2000, however, labour share becomes more stable along with the financial markets in Korea.

### 2.4 Self-employment Adjustments

The above-mentioned measure of labour share does not include labour income from the self-employed, which constitute a significant part of total employment in developing countries.[14] Ignoring self-employment in the total labour compensation would distort the cyclical behaviour of labour shares only if there were significant shifts across different occupations. Here, I discuss how sensitive the cyclical properties documented in Table 1 are to correc-

[13]The $t$-statisitc and $p$-value from a sample-mean test between emerging economies that do not face significantly countercyclical interest rates and developed economies are 1.36 and 0.19, respectively.

[14]The ratio of self-employment averages 30% in emerging markets, whereas it is 12% in developed markets.

tions with self-employment. I apply adjustment methods as in Gollin (2002) in order to take into account the labour income of self-employed people. The first method is to include only incorporated businesses when computing labour share. This requires a deduction in value-added GDP by an amount equal to self-employed income (mixed income):

$$\text{Adj-1}: \qquad \text{Labour Share} = \frac{\text{Labour Compensation}}{\text{Value-Added GDP - Mixed Income}}.$$

The adjustment shown above assumes that labour share is the same across incorporated and unincorporated (self-employed) enterprises and can be applied only to countries that report mixed income in their national accounts. For those that do not report mixed income, the second adjustment method is to compute a proxy for the labour income of a self-employed person and then adjust the overall economy labour share using data on self-employment ratios from the OECD and International Labour Organization (ILO) statistics:

$$\text{Adj-2}: \quad \text{Labour Share} = \frac{\text{Labour Comp.} + \text{Labour Income per Self-Emp.} \times \text{Self-Emp.}}{\text{Value-Added GDP}}.$$

Labour compensation per employee is calculated by the total labour compensation divided by the number of employees, and this is used as a proxy for the labour income of a self-employed person, as in Gollin (2002). The assumption that the labour cost of the self-employed is equal to the labour compensation per employee might not be valid for some countries, however. This method lifts the level of labour share up to a very high fraction of income in countries where the self-employment ratio is very high, such as Korea and Turkey.[15] The Korean labour share, for example, rises to 80-90% levels after this correction. I then check household surveys in Korea, and verify that the total *gross* income of a self-employed person is around 60% of the average gross wage level. One reason for this is that much of self-employment comes from rural areas, where the pay is lower. In addition, there might be differences in terms of skills across average workers and those who are self-employed. Furthermore, the self-employed often work in the informal sector, for which the administrative cost of labour, such as labour income tax and social security payments, do not show up on records. Since the total income of a self-employed person also includes the individual's capital income, one should expect for the self-employed a labour compensation lower than 60% of average labour compensation per employee. In the calculations, I assume that the labour income of a self-employed person is half the labour cost of an employee in Korea and Turkey.

The results for adjusted labour share are reported in Table 3. There are only minor changes after self-employment corrections. Adjusted labour share still shows a high volatility, and a positive relationship with output. When I plot these adjusted observations with

[15]Korea and Turkey have the highest self-employment ratios in the sample taken here. Half of the employed people are working for themselves.

the cyclical properties of interest rates (see Figure 5) in order to compare them with our initial unadjusted Figure 2, the main result still holds: the more countercyclical are interest rates, the more procyclical is labour share. This shows that the high procyclicality of labour share in countries such as Argentina, Korea and Mexico is not a measurement error from a calculation that ignores self-employment.

Self-employment is not a concern for the cyclical properties of labour share in these economies because this part of employment does not show a significant co-movement with output. Table 4 shows the correlations of the cyclical component of self-employment and total employment with output in some emerging markets with procyclical labour share. Although self-employment is less correlated with output relative to total employment, this is not significant enough to reverse the results for overall labour share. In addition, I note that the contribution of the self-employed to GDP – mixed income divided by GDP – is only around 10-15%, although they constitute around 30% of total employment.

### 2.5 Discussion on Sectoral Shifts and the Informal Sector

Another driving force in the change of labour share might be the change of the contribution of different sectors over the cycle. Moreover, government expenditure can amplify these shifts by investing in labour-intensive sectors. Indeed, government expenditure is procyclical in these countries. I show in Kabaca (2013) that the cyclical properties of the labour share in the overall economy documented above appear in different individual industries as well. In addition, I check whether the overall economy labour share is driven by cyclical government spending. The results indicate that labour share in the business sector, excluding public sectors such as health, education and public administration, is still volatile and procyclical.

Another important issue for low-income countries is the high ratio of employment in the informal sector. Comparable estimates from ILO suggest that developing countries in our sample have informal employment (in both formal and informal enterprises) ranging between 40% and 60% of total employment.[16] Labour compensation in the informal sector, however, is not usually represented in the national accounts by the income approach for developing countries.[17] On the other hand, value-added GDP includes estimates of the production in the informal sector. In these countries, though, an important part of employment in the informal sector actually comes from unregulated self-employment (see Thomas, 1992, De Soto, 1990). Therefore, adjustments done for the self-employed partially correct the

[16]Informal employment refers to the self-employed in their own informal sector enterprises, contributing family workers (unpaid), members of informal producers' co-operatives (not established as legal entities), employees holding informal jobs (i.e., jobs not subject to national labour legislation, income taxation, social protection or entitlement to certain employment benefits, such as sick leave), and own-account workers engaged in the production of goods exclusively for own final use by their household.

[17]Having said that, I should also note that informal employment in the formal sector is included in the official labour compensation, since the data are usually derived from estimates from formal enterprises. It is the employment in the informal sector that is missing in the official compensation of employees.

problem with the informal sector, too.

Since time-series data on the informal sector are usually neither long enough nor available for many countries, I analyze comparable cross-section data on informal employment obtained from ILO, in order to determine whether different cyclical patterns exist in different levels of the informal sector. It is possible that a large informal sector would absorb more employment during recessions, which would push the labour share down, making labour share more procyclical. Figure 6 plots the cyclical patterns of labour share with respect to informal employment observed in developing countries with comparable data. If the informal sector – strictly speaking, the lack of an informal sector in the labour compensation – were the main driver of the procyclical labour share, we would observe a higher correlation between labour share and output in countries with a larger informal sector, but we do not observe such a pattern. In fact, countries with the highest ratios of informal employment (Colombia and India) have a significantly smaller correlation of labour share with output than the others. Therefore, it is hard to say that the informal sector accounts for the procyclical labour share.

# 3 Model

The model is a small open-economy, real business cycle (SOE-RBC) model with an internationally traded single good.[18] Asset markets are incomplete in the sense that there is only one internationally traded, one-period bond which pays the buyer a predetermined interest. Agents face shocks to the interest rate on bonds and to the productivity level. These shocks follow exogenous processes, the details of which are described below. The difference from a standard RBC model is that wages have to be paid in advance and that the economic agent is credit constrained.

## 3.1 Optimization Problem

Let us consider an economy with an infinitely lived, self-employed, representative household.[19] The agent derives utility from consumption, $c_t$, and leisure, $1 - l_t$, where the total time that the agent devotes to labour and leisure is normalized to one. His preferences are

[18] Our main motivation for a real business cycle model – rather than a model with nominal rigidities – is the high CPI and wage inflation observed in developing countries. Thus, I verify that nominal wages are also highly volatile in these economies.

[19] This is similar to the yeoman-farmer model, in which the farmer's own labour is used to produce the good, which is widely used in monetary literature (see Ball and Romer, 1990, Mankiw, 1985, Mendoza, 2010). The alternative is to use a decentralized representation which has households and firms as separate agents. I choose this type of modeling since it allows us to impose a constraint on the whole nationwide debt, including both household debt and working capital loans.

described as follows:

$$\sum_{t=0}^{\infty} \beta^t E_t u(c_t - N(l_t)),$$

where $0 < \beta < 1$ is the discount factor, $u(.)$ is twice-continuously-differentiable and a concave period utility function, and $N(.)$ expresses the disutility of labour which is twice-continuously-differentiable and a convex function. This utility representation is known as GHH preferences after Greenwood et al. (1988). These preferences eliminate the wealth effect and make labour supply decisions independent of consumption. They are widely used in the open-economy macroeconomic models, since they tend to generate more realistic employment movements in open economies (see, among others, Devereux et al., 1992; Neumeyer and Perri, 2005).[20]

The agent maximizes lifetime expected utility and chooses the optimal sequences of consumption, $c_t$, labour, $l_t$, investment, $x_t$, and bond holdings, $b_t$, subject to budget and leverage constraints:

$$c_t + x_t + b_t + \kappa(b_t) \leq y_t - \theta(R_t - 1)w_t l_t + R_{t-1}b_{t-1} \tag{2}$$

$$b_t - \theta R_t w_t l_t \geq -\psi_t y_t. \tag{3}$$

Income, in this economy, is generated by producing a single traded good, $y_t$, using a constant-returns-to-scale technology that has capital, $k_t$, and labour, $l_t$, as the factors of production:

$$y_t = A_t F(k_t, l_t) = A_t k_t^{\alpha} l_t^{1-\alpha}, \tag{4}$$

where $\alpha$ is the capital elasticity in the production and $A_t$ is the total factor productivity (TFP). The agent chooses an investment level, $x_t$, in order to accumulate capital by taking into account the fact that capital depreciates at a rate, $\delta$. Capital accumulation follows the law of motion:

$$x_t = k_{t+1} - (1 - \delta)k_t + \Phi(k_{t+1}, k_t), \tag{5}$$

where $\Phi(k_{t+1}, k_t)$ is a quadratic convex capital adjustment cost to mitigate the excessive volatility of investment that might arise in small open-economy models. The agent can also trade an international one-period bond, $b_t$, in the market that has a gross return, $R_t$. A quadratic convex cost function, $\kappa(b_t)$, is introduced into the model as in Schmitt-Grohé and Uribe (2003) to ensure a stationary path for bond holdings.[21]

The model has wage bill financing, where a fraction, $\theta$, of the wage bill has to be paid in advance of the production. This can be rationalized either by the fact that workers want

[20]Note that the use of different preferences does not change our results on labour share movements, since the source of the variation in labour share – working capital – mainly comes from the demand side in the labour market. Different preferences only affect the contribution of wages and employment to these movements.

[21]This cost is zero in imperfect credit since non-stationarity does not exist in this case, and it is so small in the perfect-credit case that it does not affect the long-run business cycle implications of the model.

to consume in the beginning of the period but cannot access the financial markets, or by having a production line where firms use instalments or post-dated checks so that sales are cashed out in later periods. In the model, the shocks are realized at the beginning of period $t$, and working capital loans are borrowed from international markets at the same rate as on the bond, $R_t$, which generates interest payments at the end of the period to the rest of the world (see Figure 7). That is why the income net of these payments is entered in the right-hand-side of the budget constraint.

The labour market is competitive. Therefore, the wage is taken as given by the representative agent and is equal to the marginal disutility of labour:

$$w_t = \partial N(\bar{l}_t)/\partial \bar{l}_t, \tag{6}$$

where $\bar{l}_t$ is the market average. This is similar to the optimal labour supply in a decentralized competitive equilibrium set-up.

An important feature of this model is that the economy faces an external leverage constraint given in equation (3). The net foreign asset is constrained to a fraction of output. In other words, net debt including working capital loans has to be smaller than a $\psi_t$ fraction of output. I examine cases where the constraint is binding (imperfect credit) and non-binding (perfect credit).[22] In addition, the credit criterion in the leverage constraint, $\psi_t$, has a stochastic component and varies over time. Ludvigson (1999) finds that forecastable (ex-ante) credit growth has a significant influence on consumption that is independent of variation in predictable income growth. Furthermore, she shows that introducing a stochastic upper limit on the debt-to-output ratio improves the correlation between consumption and income growth in the United States. A high correlation between consumption and income appears in emerging markets, as well.[23] In the quantitative exercise, we will see that the model with perfect credit cannot account for highly volatile (and highly cyclical) consumption and countercyclical net exports even in the presence of countercyclical interest rates and the working capital mechanism. A stochastic leverage constraint, when binding, however, can further improve these results.[24]

Under binding credit constraints, $\psi_t$ represents the leverage ratio of the economy as the net debt over GDP. Since interest rates are an important driving force in emerging-market

[22] In this work, I narrow the scope to see how the presence of binding constraints interacts with working capital by assuming that the constraint either binds permanently or does not bind. Moreover, the solution approach applied does not allow us to study occasionally binding constraints. However, considering the low levels of financial development in emerging markets, these kinds of constraints are likely to bind due to the riskiness of emerging-market assets. In fact, Stiglitz and Weiss (1981) show that financial imperfections, as in the form of quantity restrictions, can be an optimal equilibrium outcome in every state of nature when there are asymmetric information costs in the environment.

[23] See Aguiar and Gopinath (2007) for the documentation of business cycle regularities in emerging markets.

[24] Sarquis (2008) and Guajardo (2004) also explore the effects of these types of credit shocks in emerging-market business cycles. The difference here is that I introduce the working capital channel in order to explore the effect of changes in the effective cost of borrowing on labour market variables.

economies, the leverage ratio is assumed to move over the cycle in the following way:

$$\widehat{\psi}_t = -\eta \widehat{R}_t, \tag{7}$$

where $\eta > 0$. Thus, the economy faces credit restrictions (such as losing access to financial markets) during financial crises when spreads and interest rates are high. Our motivation comes from the empirical evidence on foreign credit to the private sector in emerging markets, which shows that foreign credit is quite sensitive to interest rate movements. Arteta and Hale (2008) find debt crises are accompanied with a significant and persistent drop in foreign credit even after controlling for fundamentals. In addition, Fostel and Geanakoplos (2008) document that, during closures, emerging-market bond issuance drops in mild recessions even though its spread has increased only minimally relative to other assets. They show that this phenomenon can be explained in a financial environment where lenders cannot distinguish bad credit from good credit. Therefore, the exogenous structure of the leverage ratio can be endogenized through the mechanism in Fostel and Geanakoplos (2008), which implies a positive correlation between tightening in credit standards and interest rates.[25] Furthermore, an increase in asymmetric information costs, driving spreads up for these economies, can cause monopolistically competitive banks to not only charge high interest rates but also to impose tighter restrictions on credit, as in Stiglitz and Weiss (1981). Our specification would imply a one-to-one relation between interest rates and the leverage ratio.[26]

### 3.2 Competitive Equilibrium and Labour Share

A competitive equilibrium for this economy consists of sequences of optimal allocations $\{c_t, l_t, k_{t+1}, b_t, x_t, y_t\}$ and wages $\{w_t\}$ such that

1. the representative agent solves the maximization problem subject to budget and collateral constraints in (2) and (3), taking wages, the interest rate, and initial states $k_0$ and $b_0$ as given,
2. wage equals the marginal disutility of labour $w_t = \partial N(\bar{l}_t)/\partial \bar{l}_t$,
3. labour decisions satisfy $\bar{l}_t = l_t$, and
4. the goods market clears, i.e., goods that are not spent on consumption, investment and the cost of bond holdings represent the net exports for the economy:

$$c_t + x_t + nx_t + \kappa(b_t) = y_t. \tag{8}$$

[25]The external borrowing is crucial here, since a model with heterogeneous agents and binding collateral constraints in a closed economy might imply a negative correlation between those two variables under endogenous interest rates.

[26]The observed relationship between these two variables in the data is consistent with these explanations. The private sector credit-to-GDP ratio for non-financial firms shows a high correlation of -0.60 with interest rates in Mexico.

The optimal condition for bond holdings and capital accumulation can be expressed as

$$\lambda_t[1+\kappa'(b_t)] = \mu_t + E_t\lambda_{t+1}\beta R_t \tag{9}$$
$$\lambda_t[1+\Phi_{1,t}] = \beta E_t[\lambda_{t+1}(1+A_{t+1}F_{1,t+1}-\delta-\Phi_{2,t+1})+\mu_{t+1}\psi_{t+1}A_{t+1}F_{1,t+1}],$$

where the number of subscripts in the functions $\Phi(k_{t+1},k_t)$ and $F(k_t,l_t)$ denote the partial derivatives of the function with respect to its argument numbered. These conditions tell us that bond holdings and capital accumulation are at their optimal level when the cost of an additional bond/capital accumulation is equal to the discounted benefit to the households. The expression $\mu_t$ is the Lagrange multiplier on the leverage constraint at period $t$ representing the marginal value of relaxing the leverage constraint. The other Lagrange multiplier on the budget constraint, $\lambda_t$, stands for the marginal utility of consumption:

$$\lambda_t = u_c(c_t,l_t). \tag{10}$$

Finally, the optimal condition for labour demand in this economy can be written as follows:

$$-u_2(c_t,l_t) = \lambda_t[A_tF_2(k_t,l_t)-\theta(R_t-1)w_t]+\mu_t[\psi_tA_tF_2(k_t,l_t)-\theta R_tw_t].$$

This condition states that the marginal cost of increasing labour input has to be equal to the marginal benefit of labour to the household. Combining this equation with the wage rate formula described above and the relationship $\frac{\partial N(l_t)}{\partial l_t} = -\frac{u_2(c_t,l_t)}{u_1(c_t,l_t)}$, we can express the (inverse) labour demand in this economy as follows:

$$w_t = \frac{1+\frac{\mu_t}{\lambda_t}\psi_t}{1+\theta(R_t-1)+\frac{\mu_t}{\lambda_t}\theta R_t}A_tF_2(k_t,l_t). \tag{11}$$

Next, I consider the effects of working capital and credit constraints on labour share. In order to see the contribution of each friction, I first examine the case in which the upper limit on borrowing is infinitely high, i.e., the agent is not credit-constrained and $\mu_t = 0$ for every $t$. In this case of perfect credit, the expression for labour share follows:

$$s_t = \frac{w_tl_t}{y_t} = \frac{1-\alpha}{1+\theta(R_t-1)} \qquad \textbf{(perfect credit)}, \tag{12}$$

where $s_t$ is the labour share at period $t$ and $\alpha$ is the capital exponent in the production function. Equation (12) tells us that labour share would still be moving even when the credit market is frictionless, since wages deviate from the marginal product of labour.[27]

[27] In a decentralized set-up, a similar implication can be derived from firm maximization as in the following:

$$\max_{k_t,l_t} \qquad F(A_t,k_t,l_t) - r_t^kk_t - (1+\theta(R_t-1))w_tl_t.$$

This maximization problem produces the same labour share as in equation (12) when the Cobb-Douglas production function is taken.

An increase (decrease) in interest rates drives the wage to a lower (higher) level than the marginal product of labour, which reduces (increases) the labour share of income and increases (decreases) the share of the interest payments in the output.
When the credit constraint is introduced, the effect of this mechanism is amplified:

$$s_t = \frac{w_t l_t}{y_t} = \frac{(1-\alpha)(1+\frac{\mu_t}{\lambda_t}\psi_t)}{1+\theta(R_t-1)+\frac{\mu_t}{\lambda_t}\theta R_t} \qquad \textbf{(imperfect credit)}. \tag{13}$$

Since the increase in $R_t$ is accompanied by the credit constraint, implying that $\frac{\mu_t}{\lambda_t}$ and $R_t$ are positively correlated to each other, a shock to the interest rate will further increase the effective interest rate and influence the labour share more adversely. Intuitively, the demand for labour is lowered not only because of the higher cost of borrowing, but also because of the higher credit restrictions imposed by lenders on firms seeking loans for working capital needs. Note that since labour decisions affect output (which further tightens or loosens the credit constraint), $\frac{\mu_t}{\lambda_t}\psi_t$ appears in the numerator. However, because $\frac{\mu_t}{\lambda_t}$ and $\psi_t$ are moving in different directions over the cycle, the impact is mostly driven by the denominator.

If a share of income changes, then some other shares have to as well. I write down the income components of output and explain the changes in the share:

$$y_t = w_t l_t + r_t k_t + \underbrace{\theta(R_t-1)w_t l_t}_{\text{interest payments on working capital loans}}.$$

The interest cost on the wage bill increases when interest rates rise. In a perfect-credit world, the capital share remains constant, since there is no distortion between capital return and the marginal product of capital. Therefore, in the books of national account, labour income share, $\frac{w_t l_t}{y_t}$, falls, and the share of payments to the rest of the world increases. In the presence of binding leverage constraints, the rate of return on capital remains higher than it would be under the non-binding case; therefore, capital share increases as an immediate response to positive interest rate shocks, since capital stock cannot change at the time of the shock. Thus, the decline in labour share in the imperfect-credit case would be higher, since both the share of interest payments and of capital income rises.

# 4 Calibration

Equations (2)-(13), along with the shock processes, constitute the system of equations for the endogenous variables. These equations are log-linearized, and then solved for the policy functions in terms of endogenous state variables, $\{k_t, b_{t-1}\}$, and exogenous state variables, $\{A_t, R_t\}$. The model is then calibrated to quarterly data for Mexico, given its longer data at the quarterly frequency and representative movements of labour share of emerging markets,

specifically a procyclical and volatile labour share. The sample period is from 1987Q1 to 2008Q4. Table 5 summarizes the parameter values and Figure 8 shows the cyclical pattern of the Mexican labour share with the output, which I attempt to explain.

### 4.1 Shocks

I assume that shocks to productivity (in logs) and interest rates (log of *gross* interest rate) are correlated simultaneously such that $\epsilon_t = [\epsilon_t^A, \epsilon_t^R]$ is drawn from an i.i.d. normal bivariate distribution, $N(0, \Sigma)$, with zero mean and covariance, $\Sigma$. Each shock follows an independent AR(1) process[28]:

$$\widehat{A}_t = \rho_A \widehat{A}_{t-1} + \epsilon_{A,t}$$
$$\widehat{R}_t = \rho_R \widehat{R}_{t-1} + \epsilon_{R,t},$$

with

$$\Sigma_{\epsilon_t \epsilon_t'} = \begin{pmatrix} \sigma_{\epsilon_A} & \rho_{\epsilon_A,\epsilon_R}\sigma_{\epsilon_A}\sigma_{\epsilon_R} \\ \rho_{\epsilon_A,\epsilon_R}\sigma_{\epsilon_A}\sigma_{\epsilon_R} & \sigma_{\epsilon_R} \end{pmatrix}.$$

Solow residuals are used as the measure of productivity.[29] Detrended Solow residuals suggest an AR(1) coefficient of 0.75 and standard deviation of 1.34% of shocks to TFP.

For interest rates, I have two representative series: EMBI rates and short-term treasury bill rates for Mexico. EMBI rates cover only half of the sample. On the other hand, I have T-bill rates for the whole sample period from the IFS.[30] Both series are deflated using the U.S. GDP deflator for EMBI rates and the domestic GDP deflator for treasury bill rates. The behaviour of the cyclical component of domestic interest rates is consistent with Kaminsky et al. (2004). They show that domestic interest rates are volatile and countercyclical in most of the developing countries. I find that both interest rate series have a negative correlation with output above -0.50 in Mexico. In addition, both series share a similar persistence of around 0.60.

Despite the similar co-movement between foreign- and domestic-currency denominated bond rates, the volatility differs dramatically. The quarterly yields from EMBI-constructed detrended interest rates has a standard deviation of 0.44%. On the other hand, domestic interest rates are four times more volatile, at 2.01%. This difference is mainly due to the exchange rate risk. Indeed, previous literature on emerging-market crises emphasizes the burden of the foreign-currency denominated debt, since these countries experience sharp depreciation during their economic slowdowns. Lending to emerging economies in their own currency is risky. Similarly, borrowing in foreign currency is risky in the eyes of firms

[28] I verified that a VAR estimation of these shocks results in insignificant coefficients for the lags, consistent with results from the previous literature. See, for instance, Mendoza (2010).

[29] See Appendix B for the construction of Solow residuals.

[30] I take the first two years of observations out of the sample, since they represent abnormal changes from -20% to 100% of real return. This is done in order for the results not to be driven by these variations.

in emerging markets, since this increases debt service costs during periods of falling output because of depreciation (Calvo, 1988; Gumus, 2013; Jeanne, 2003; King and Rebelo, 1999).[31] Since the model does not include monetary terms, assuming a low volatility of rates will overpredict the effect of imperfect credit. Given large volatility difference, I assume that shocks to interest rates have the same volatility as productivity shocks, that is equal to 1.34%. This corresponds to a number within the range of deviations observed in those two series.[32] The correlation between shocks to TFP and interest rates is estimated to be equal to -0.45 using foreign rates.[33]

For the stochastic leverage ratio, I set $\eta$ in equation (7) to be 1.82 so that the standard deviation of $\psi_t$ matches the standard deviation of credit-to-GDP ratio for the private sector over the sample period. This number suggests that the debt-to-income rule decreases by 1.82% when quarterly interest rates rise by 1%.

## 4.2 Other Model Parameters

Using the average interest rate level and depreciation rate, I extract the values for the discount factor and the steady-state shadow price of credit constraint simultaneously from optimal bond holding and capital equations at the steady state. Calculations result in $\beta = 0.98$ and $\frac{\overline{\mu}}{\lambda} = 0.01$. The capital exponent is calibrated to match the average labour share in Mexico over the sample period, i.e.,

$$\frac{1-\alpha}{1+\theta(\overline{R}-1)} = 0.57.$$

The above equation implies $\alpha = 0.43$ when $\theta = 0.66$.[34] The Mexican labour share using the National Accounts data is small even when it is adjusted to take into account the labour income from self-employment (around 40%). This is partly because labour compensation data from National Accounts come from the formal sector in developing countries. I further adjust the labour share using the data on the contribution of the informal sector to Mexican GDP from 1993-2004.[35] This implies that the average labour share over this period is equal to 0.57, a number closer to that in developed economies.

[31] Moreover, Kaminsky et al. (2004) show that monetary policies are procyclical with output in emerging markets. These policies (such as increasing nominal interest rates to prevent capital outflows) might have an impact on the real interest rate.

[32] It is close to other parameter values used in the literature for the deviation of interest rates. See Mendoza (2010) and Li (2011).

[33] The estimated correlation coefficient is -0.48 when T-bill rates are used.

[34] The capital exponent is equal to 0.42 when $\theta = 1$.

[35] The implicit assumption here is that labour content is the same across formal and informal sectors. Note that one can imagine a higher labour share for the informal sector. A higher share, say a 20% higher labour share than in the formal sector, increases the level of labour share in the overall economy by only a couple of percentage points, since the informal sector's contribution is smaller in value (around 12%). In terms of volatility, a higher share in the informal sector would actually make the labour share more volatile because the informal sector is procyclical.

The functional form for the utility function is the following:

$$u(c_t, l_t) = \frac{1}{1-\sigma}[c_t - \xi l_t^v]^{1-\sigma}. \tag{14}$$

Intertemporal elasticity of substitution is set to 0.2, which implies $\sigma = 5$ following Neumeyer and Perri (2005), who use the same preferences as in the model presented here. Using the optimal labour supply equation at the steady state, labour weight parameter $\xi$ in the utility function is set to match $\bar{l} = 0.32$, which is the fraction of hours worked in the total non-sleeping hours. The total hours worked time-series in manufacturing from the OECD monthly economic indicators data set is used in the calculation of the steady-state value of hours, $\bar{l}$. In the model, $v$ determines the Frisch elasticity of the labour supply, $\frac{1}{v-1}$. The empirical evidence on this parameter is mostly coming from developed markets and the values used in the literature are in the range [0.5,1]. Considering their lower income and wealth, I assume that agents in emerging markets stand closer to the lower bound of this range and set the value of $v$ to 2.75 showing an elasticity of labour, 0.57, which implies a standard deviation of hours closer to data. Although this parameter is not crucial for the results on labour share fluctuations, it changes how the movements in the wage bill are split between the labour input and hourly wages. Finally, I calculate the net foreign assets held by the households at the steady state as the average over the sample period using the data set on countries' external asset positions from Lane and Milesi-Ferretti (2007).

# 5 Results

Figure 9 shows the impulse responses from models with perfect and imperfect credit. In addition, Table 6 reports the volatility implications of different versions of the calibrated model along with the second moments from the data. The data moments represent quarterly variations after taking logs (except the net export-GDP ratio and net interest rate) and HP-filtering with a smoothing parameter of 1600.[36] Quarterly labour share data in manufacturing are used as a proxy of overall labour share fluctuations in the economy.[37] I check that, at the annual level, series from both manufacturing and the total economy are highly correlated to each other (0.86) and have large standard deviations of 4.5% and 3.5% in the manufacturing and overall economy, respectively. The second column in Table 6 lists the moments from the standard SOE-RBC model for comparison, and the remaining columns document the results of the model described above in both cases of perfect- and imperfect-credit markets for different values of the working capital parameter.

[36] ARIMA-X12 from the Census Bureau is applied to deseasonalize data when there are significant seasonal effects.

[37] The trend and cyclical components of the Mexican labour share are plotted in Figure 8.

**SOE-RBC Model.** To begin with, the results from the standard SOE-RBC model cannot generate any movements in labour share, because the Cobb-Douglas production technology implies a constant labour share in a competitive environment where wage is equal to the marginal product of labour. Consequently, it cannot account for the volatility in labour market variables. As mentioned earlier, real wages are more volatile than output in emerging markets, but even with the relatively inelastic labour supply assumed, SOE-RBC has difficulty explaining highly volatile wages.

One of the most distinguishable characteristics of fluctuations in emerging markets emphasized in the literature is that they have highly volatile and cyclical consumption and net-exports-to-GDP ratios. The standard model also fails to adequately explain these features in emerging markets, since agents tend to smooth their consumption using credit markets when the shocks are temporary.[38]

**The Model with Working Capital and Perfect Credit.** The results from the model with working capital in an environment with perfect credit are reported in the third column of Table 6. The introduction of working capital without any limits on borrowing can generate variations in labour share. Because interest rates are countercyclical, a working capital requirement tends to produce a larger response in labour demand than in the standard SOE-RBC model. As a consequence, wages and hours become more volatile in these models. Having a more volatile wage bill results in a procyclical labour share, consistent with the data. Although the model could predict the movements of labour share with output, the volatility depends heavily on the working capital parameter, $\theta$. The results from the model with a lower working capital requirement are reported in the fifth column. A smaller value for this parameter significantly lowers the volatility of labour share.

Although they predict some of the volatility in labour share, the models with perfect credit can explain neither the strong countercyclicality in the net exports-GDP ratio nor the strong procyclicality in investment. As a result, consumption tends to be less volatile than output. This occurs because, under relatively less persistent shocks, investment is less cyclical and the consumption-smoothing behaviour still appears. Consequently, net exports tend to move with output and become procyclical (or acyclical) in the perfect-credit case. These results are different from the ones in Li (2011), in which these features are generated in a model with working capital and perfect credit. One reason might be the lower elasticity of the intertemporal substitution set here. However, consumption is still less volatile than output when I use the same parameter value as in Li's paper. Another reason why she generates these regularities under the perfect-credit case is that the interest

[38] Aguiar and Gopinath (2007) show that the standard model can explain these features when non-stationary shocks are introduced into the model. However, recently, Garcia-Cicco et al. (2010) estimated that these shocks have a negligible role in emerging-market business cycles.

rate shocks in her paper are twice as volatile as TFP shocks, whereas here they are just as volatile as TFP shocks.

**The Model with Working Capital and Imperfect Credit.** Finally, the results from the model with leverage constraint are reported in columns 4 and 6 of Table 6. An imperfect-credit market makes labour share more volatile compared to the case with perfect credit, due to more volatile wages and labour input. Now, the model can explain 73% of the variations in the Mexican labour share assuming $\theta = 1$. Moreover, even with a lower working capital parameter (column 6), the model can explain a significant part of the volatility in labour share (60% of the variations). Therefore, the presence of borrowing limits allows us to set a lower working capital requirement than that used in the literature. This is quite reasonable, especially when one considers that, in some industries, working capital might be of less importance.

Imperfect credit not only increases the volatility in the labour market, but also significantly improves the implications on the fluctuations of consumption, investment and net exports over the cycle. When the leverage constraint is introduced, which makes financing even more difficult, smoothing behaviour disappears. Therefore, consumption becomes more volatile than output, and investment becomes strongly procyclical with output. As a result, the net export-GDP ratio moves inversely with output over the cycle, consistent with the data.

Note that all models presented here imply very procyclical wages. However, wages are somewhat less cyclical (0.45) in the data. This smaller cyclicality is a well-known fact in developed markets as well.[39] Wage rigidities through contracting models (see Gomme and Greenwood, 1995) and the change in skill composition of labour (see Bils, 1985) over the cycle may make aggregate wages less cyclical.[40] In addition, search-and-matching frictions in the labour market can also help explain why wage movements are less cyclical than predicted by models with a frictionless labour market (see Boz et al., 2012, Altug and Kabaca, 2014).

## 6 Implications for Developed Economies

In this section, I show the performance of the model in a developed market. I calibrate the model to Canada, where the labour share is countercyclical, and interest rates and levels of financial development are representative of those observed in developed markets. I then

[39] See Choi and Rios-Rull (2009), for instance, for the recent wage-output correlations in the United States.

[40] Introducing these features into the model will, in fact, increase the importance of working capital and the countercyclical cost of borrowing. This is because those features tend to lower the volatility of wages in models, and thus work in the opposite direction of working capital.

compare the results with the implications for Mexico. The model with the imperfect-credit market and the working capital requirement of 0.66 is taken as the baseline in this section.

As mentioned earlier, the literature suggests that the countercyclicality of the labour share in developed markets occurs due to the less-responsive (total) labour income to output changes. High unionization (especially in Europe), firing and search costs, and contractual labour markets imply sluggishness either in wages or in hours worked.[41] Based on these explanations, in order to represent labour market rigidities, I include an adjustment cost on labour input in the model. The aim is to understand how it interacts with working capital and contributes to the variability of labour share. Rigidities in the labour market exist in emerging economies as well.[42] By extending the model, we would also like to see how labour adjustment costs alter the results of the baseline model in emerging economies explained in the previous section. A convex labour adjustment cost is introduced into the model as follows:

$$\Omega(l_t, l_{t-1}) = \phi_l l_{t-1} (\frac{l_t - l_{t-1}}{l_{t-1}})^2.$$

This cost has a significant effect on the autocorrelation of hours worked. Therefore, the $\phi_l$ parameter is set to match the autocorrelation of hours worked in the data, which is 0.69 and 0.66 in Mexico and Canada, respectively. For other parameters in the calibration of the Canadian economy, I follow similar approaches applied to Mexico except that I assume a higher labour elasticity (unit elasticity, as in the literature) and a lower $\eta$, representing a higher level of financial development in Canada. More information on calibration of parameters for Canada is provided in Appendix C.

The simulation results for this extension along with the baseline model are reported in Table 7. The first columns for each country represent data moments. The baseline model, when calibrated to Canada, generates a countercyclical labour share, since interest rates are slightly procyclical in Canada. In response to a positive productivity shock, higher interest rates mitigate the response of labour demand and the total wage bill to output, producing a countercyclical labour share. However, since interest rates do not vary much, the baseline model can only explain a small part of the volatility in the labour share observed in Canada.

On the other hand, the modified version of the model with the adjustment cost on labour can explain more variation in the labour share for Canada. Sluggish labour makes both wages and hours less responsive to output, and contributes to the variability and countercyclicality of labour share, as the previous works in the literature suggest. Therefore, working capital and labour market rigidities work in the same direction in explaining the

[41] There are also other explanations for the countercyclicality of labour share in developed markets. Hansen and Prescott (2005) introduce occasionally binding capacity constraints, implying a procyclical capital share, and consequently a countercyclical labour share.

[42] Heckman et al. (2000), for example, show that employment protection is high in Latin American countries. Moreover, the OECD protection index also indicates that emerging markets such as Mexico and Turkey have much more protection on labour than the average of that among advanced economies.

movements of labour share in developed markets. Since the interest rates in developed markets are not volatile, the effect of working capital is minimal.

However, emerging markets serve as a good natural experiment given their different behaviour of interest rates. In the model economy for the emerging market, introducing labour market rigidities does not offset the effect of working capital on labour share because interest rates are much more volatile than in developed markets. Without working capital, labour share becomes negatively correlated with output, which is inconsistent with the data. This suggests that the working capital mechanism is a more dominant factor than labour market rigidities in determining the movements of labour share in emerging markets.

# 7 Conclusion

In this paper, I show that emerging markets tend to have a more volatile and procyclical labour share as opposed to a relatively stable and countercyclical one in developed markets. Procyclicality increases as the country faces stronger countercyclical interest rates. I then explore the effect of financing labour, and show that a SOE-RBC model with working capital channels explains fluctuations in labour share consistent with the data. The liquidity need for labour payments as a result of the working capital channel generates an effective cost of labour, and leads to more- (less-) responsive wages and hours when interest rates are countercyclical (procyclical) with output. Since interest rates in different country groups move in opposite directions over the cycle, the effect of the cost of borrowing varies across these groups, implying a procyclical labour share in emerging markets and a countercyclical one in developed markets.

Introducing other financial constraints that emerging economies encounter, such as credit frictions, amplifies the results by making the effective interest rate more volatile than the observed one. Binding leverage constraints not only contribute to the variability in labour share, but also improve the model performance in terms of matching other business cycle regularities in these economies, such as highly volatile consumption, strongly countercyclical net exports and procyclical investment.

Following the literature on labour share, I also include an adjustment cost on labour to represent the slow adjustment in the labour market. I find that financing labour income plays a more important role in explaining labour share fluctuations in an environment with unstable financial markets associated with highly volatile costs of borrowing, typically observed in emerging-market economies. On the other hand, labour market rigidities are more likely to contribute to labour share movements than working capital channels in countries where financial markets are stable, as in developed economies. Future research could analyze the interaction between endogenous rigidities specific to the labour market and financing wage payments.

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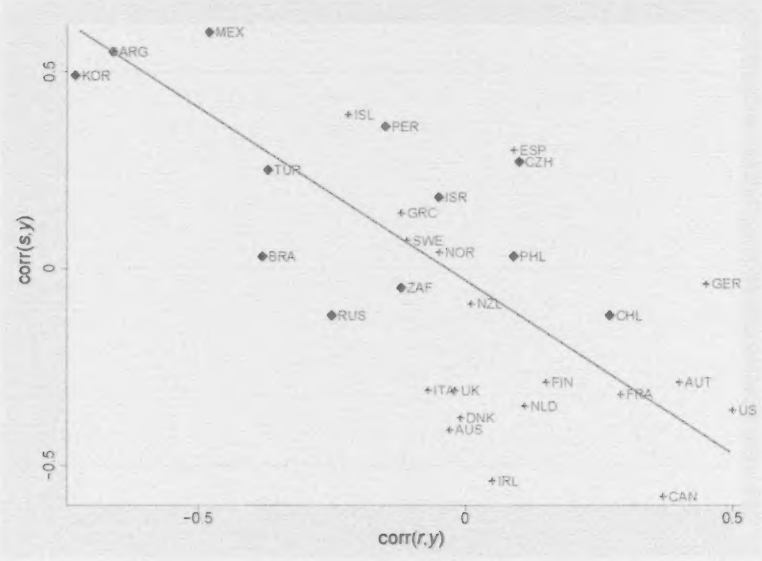
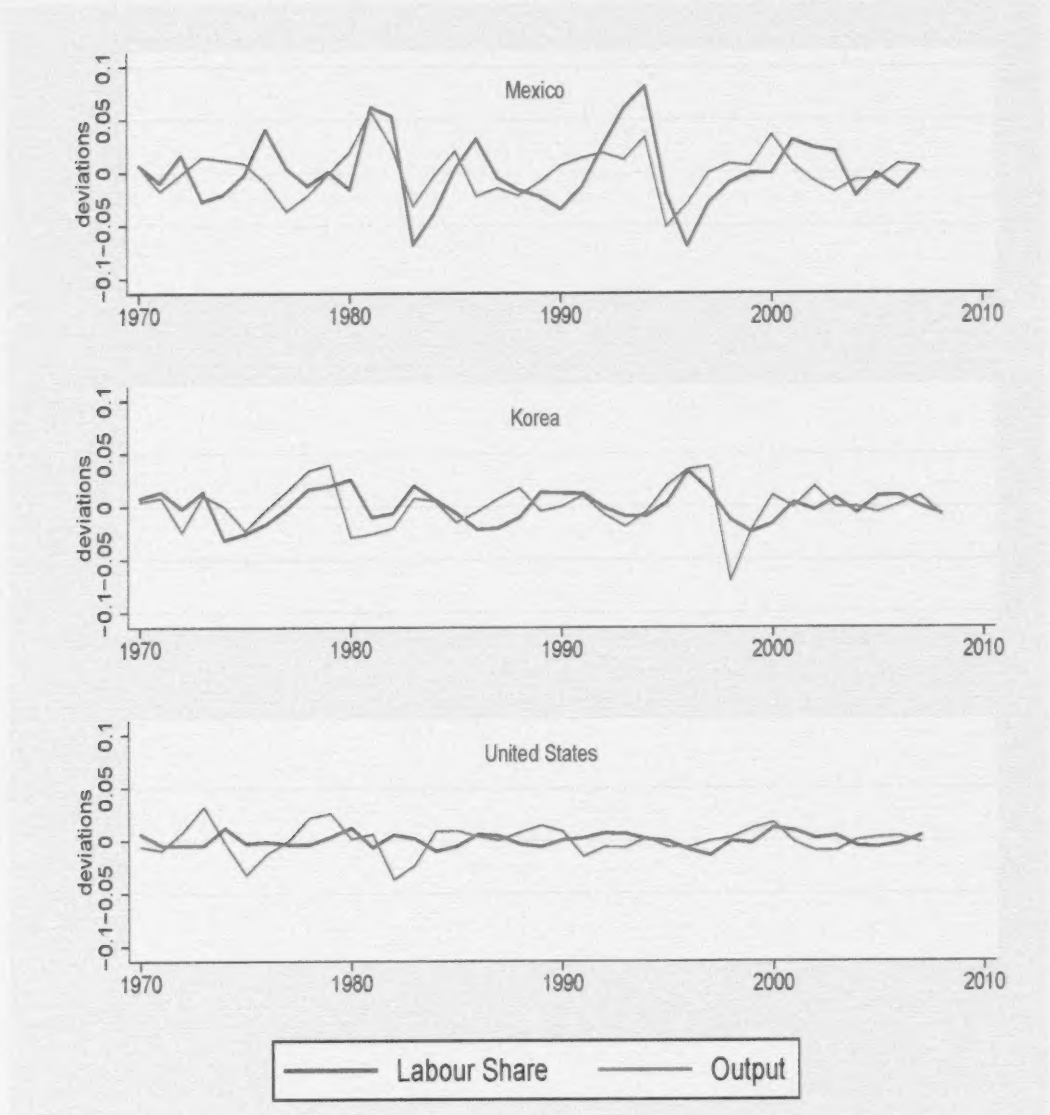
Figure 3: Correlation of Labour Share and EMBI Interest Rates with Output



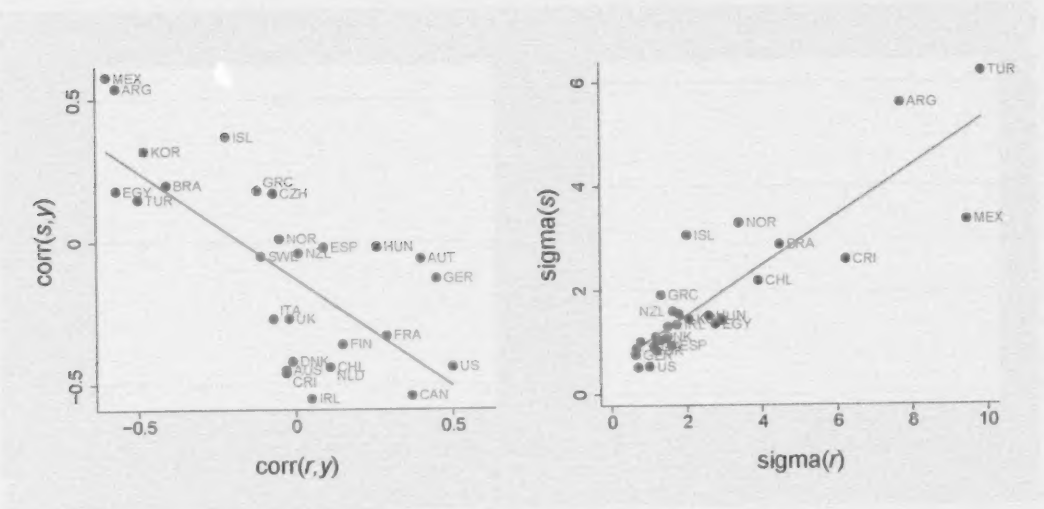

Notes: corr($s$,$y$) and corr($r$,$y$) denote the correlation of labour share with output and of interest rate with output, respectively. Interest rate data cover 1994Q1-2005Q1 for most countries and are constructed using EMBI spread data from Uribe and Yue (2006), except Argentina. Interest rate data for Argentina (1983Q1-2005Q1) come from Neumeyer and Perri (2005) until 2001Q2; I then extend the data using EMBI rates from Uribe and Yue (2006). The data are HP-filtered using annual smooth parameter, 6.25.

Figure 4: Labour Share Fluctuations in Mexico, Korea, and the United States



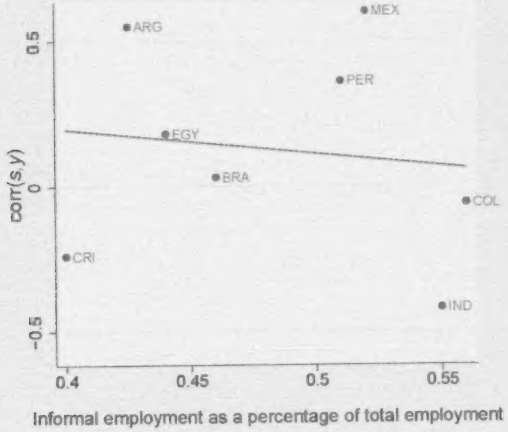

Notes: The data are annual and HP-filtered using the annual smooth parameter, 6.25. Y-axis shows percentage deviations from the trend. See Appendix A for data sources.

Figure 5: Adjusted Labour Share and Interest Rate Fluctuations




Notes: The figure replicates Figure 2 using the labour shares adjusted for self-employment. Data cover the period after 1980 for most countries. See Appendix A for data sources and Figure 2 for other details.

Figure 6: Informal Sector and the Cyclicality of Labour Share




Notes: The figure shows how the cyclical properties of labour share with output changes with the size of the informal employment. Data are obtained from the ILO-Laborstat Database. The same definitions of informal employment are used for each country.

Figure 7: Time Line

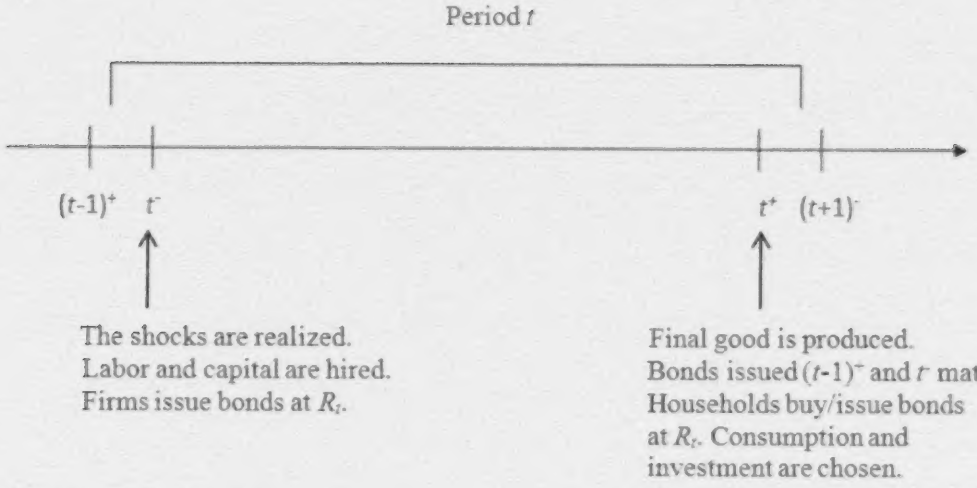
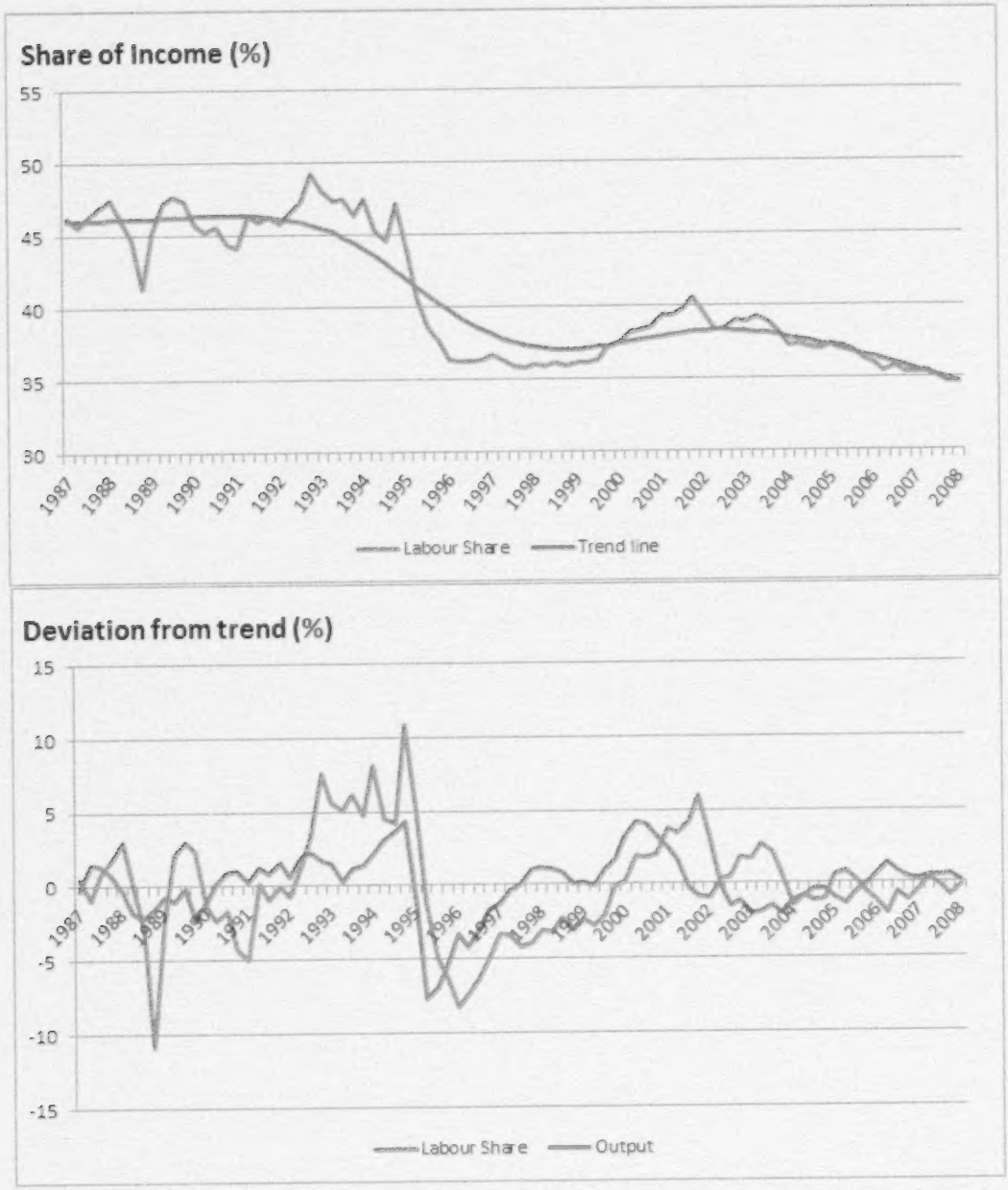
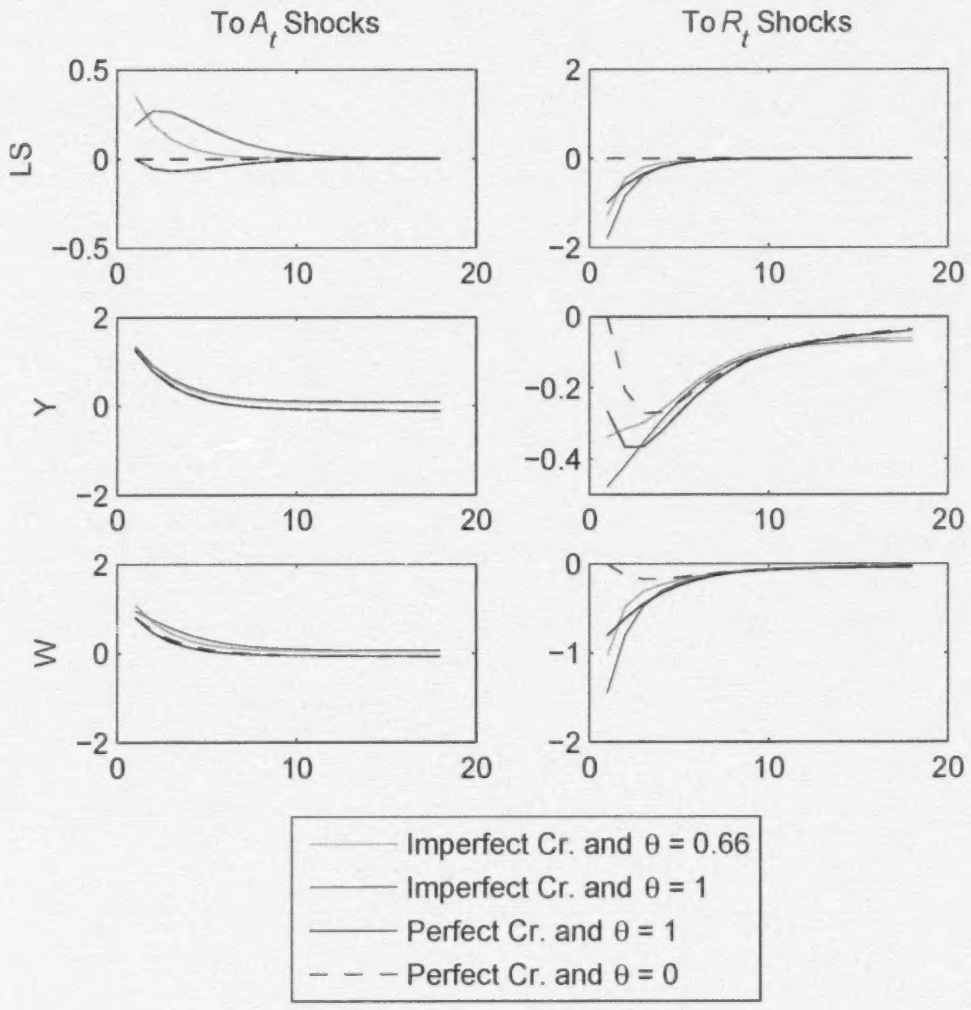


Figure 8: Labour Share in Mexico




Notes: Labour share is at a quarterly frequency and seasonally adjusted. It represents total labour cost as a share of manufacturing value-added. Labour cost is adjusted for self-employment. Cyclical components are calculated as percentage deviations from the HP-filtered trend. Source: OECD.

Figure 9: Impulse Responses




Notes: The impulse responses come from four versions of the model. The dashed line represents the frictionless SOE-RBC model without binding leverage constraints and working capital requirement. The solid black line shows responses from the model with working capital but no binding leverage constraint. The coloured lines show results from the models with binding leverage constraints, the red one assuming a lower working capital requirement.

*continued...*

Figure 9: Impulse Responses *(continued)*

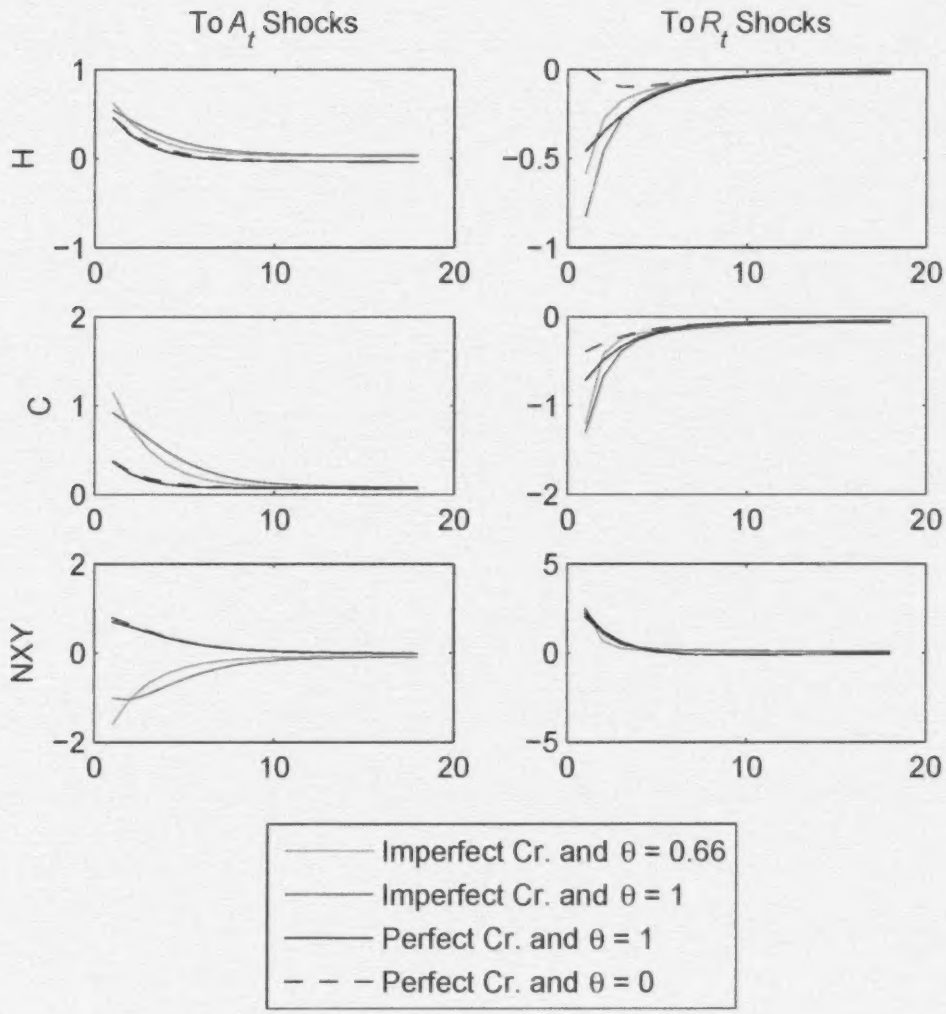


Table 1: Business Cycle Statistics of Labour Shares and Interest Rates in Emerging Markets

| | Labour Share | | | Interest Rate | | | Correlation |
|---|---|---|---|---|---|---|---|
| | Mean | Std. Dev | Corr($s$,$y$) | Mean | Std. Dev. | Corr($r$,$y$) | ($r$,$s$) |
| Argentina | 0.36 | 5.02 | 0.56 | 3.39 | 7.7 | -0.57 | -0.40 |
| | | | (0.03) | | | (0.03) | (0.13) |
| Brazil | 0.48 | 2.38 | 0.03 | 15.28 | 4.47 | -0.41 | -0.09 |
| | | | (0.92) | | | (0.19) | (0.78) |
| Chile | 0.39 | 2.36 | -0.12 | 6.45 | 3.9 | 0.11 | 0.09 |
| | | | (0.54) | | | (0.59) | (0.65) |
| Colombia | 0.36 | 1.22 | -0.06 | 3.55 | 5.07 | 0.60 | -0.14 |
| | | | (0.88) | | | (0.01) | (0.61) |
| Costa Rica | 0.48 | 2.92 | -0.22 | 0.33 | 6.23 | -0.03 | -0.06 |
| | | | (0.26) | | | (0.89) | (0.76) |
| Czech Rep. | 0.47 | 1.37 | 0.27 | 0.01 | 2.94 | -0.07 | 0.07 |
| | | | (0.30) | | | (0.79) | (0.80) |
| Egypt | 0.26 | 1.29 | 0.18 | 2.67 | 2.75 | -0.57 | -0.61 |
| | | | (0.58) | | | (0.09) | (0.05) |
| Hungary | 0.53 | 1.14 | 0.12 | 5.35 | 2.58 | 0.26 | 0.09 |
| | | | (0.67) | | | (0.36) | (0.74) |
| India | 0.36 | 1.17 | -0.44 | 7.62 | 2.8 | 0.22 | -0.52 |
| | | | (0.04) | | | (0.33) | (0.01) |
| Israel | 0.57 | 1.71 | 0.17 | 5.58 | 1.85 | 0.14 | -0.35 |
| | | | (0.57) | | | (0.66) | (0.24) |
| Korea | 0.49 | 1.36 | 0.45 | 5.39 | 2.05 | -0.48 | 0.12 |
| | | | (0.02) | | | (0.01) | (0.53) |
| Mexico | 0.33 | 3.72 | 0.60 | 9.31 | 9.46 | -0.60 | -0.59 |
| | | | (0.0) | | | (0.01) | (0.01) |
| Peru | 0.28 | 2.30 | 0.36 | 10.05 | 5.01 | -0.21 | -0.06 |
| | | | (0.07) | | | (0.40) | (0.81) |
| Philippines | 0.26 | 2.85 | 5.15 | 7.10 | 2.33 | 0.12 | -0.17 |
| | | | (0.95) | | | (0.65) | (0.52) |
| Poland | 0.44 | 1.97 | -0.19 | 6.54 | 4.42 | 0.54 | -0.34 |
| | | | (0.46) | | | (0.02) | (0.18) |
| Russia | 0.51 | 4.8 | -0.12 | 6.78 | 9.6 | 0.48 | -0.58 |
| | | | (0.68) | | | (0.09) | (0.04) |
| South Africa | 0.54 | 1.47 | -0.06 | 2.48 | 2.49 | 0.34 | 0.12 |
| | | | (0.76) | | | (0.03) | (0.44) |
| Turkey | 0.27 | 6.40 | 0.25 | 15.84 | 9.86 | -0.49 | -0.24 |
| | | | (0.30) | | | (0.02) | (0.31) |
| **Mean** | **0.41** | **2.48** | **0.10** | **6.21** | **4.74** | **-0.05** | **-0.20** |
| **Mean*** | **0.49** | **2.98** | **0.34** | **7.74** | **5.53** | **-0.43** | **-0.23** |

Notes: The table lists standard deviation and correlation statistics for labour shares in Figures 1 and 2. $P$-values are shown in parentheses. Mean* represents the average for countries with countercyclical interest rates: Argentina, Brazil, Czech Republic, Egypt, Korea, Mexico, Peru and Turkey. Interest rates are net annual domestic rates from the IFS. See Appendix A for other data sources and the sample period for each country.

Table 2: Business Cycle Statistics of Labour Shares and Interest Rates in Developed Markets

| | Labour Share | | | Interest Rate | | | Correlation |
|---|---|---|---|---|---|---|---|
| | Mean | Std. Dev | Corr($s,y$) | Mean | Std. Dev. | Corr($r,y$) | ($r,s$) |
| Australia | 0.56 | 1.05 | -0.41 | 4.87 | 1.45 | -0.03 | 0.62 |
| | | | (0.02) | | | (0.50) | (0.0) |
| Austria | 0.58 | 0.65 | -0.29 | 2.87 | 0.65 | 0.40 | -0.06 |
| | | | (0.08) | | | (0.08) | (0.80) |
| Canada | 0.60 | 1.06 | -0.58 | 3.97 | 1.30 | 0.37 | -0.22 |
| | | | (0.0) | | | (0.06) | (0.26) |
| Denmark | 0.63 | 1.18 | -0.38 | 3.48 | 1.16 | -0.03 | -0.05 |
| | | | (0.05) | | | (0.0) | (0.81) |
| Finland | 0.58 | 1.74 | -0.29 | 3.80 | 1.79 | 0.15 | 0.32 |
| | | | (0.13) | | | (0.49) | (0.14) |
| France | 0.61 | 0.50 | -0.32 | 3.64 | 0.70 | 0.29 | 0.13 |
| | | | (0.09) | | | (0.13) | (0.50) |
| Germany | 0.60 | 0.79 | -0.04 | 3.34 | 0.63 | 0.45 | 0.09 |
| | | | (0.88) | | | (0.01) | (0.64) |
| Greece | 0.36 | 1.96 | 0.14 | 2.11 | 1.31 | -0.12 | -0.23 |
| | | | (0.49) | | | (0.54) | (0.64) |
| Iceland | 0.62 | 2.8 | 0.39 | 5.23 | 2.01 | -0.22 | -0.03 |
| | | | (0.03) | | | (0.0) | (0.89) |
| Ireland | 0.50 | 1.4 | -0.54 | 3.60 | 1.73 | 0.05 | -0.06 |
| | | | (0.01) | | | (0.87) | (0.75) |
| Italy | 0.48 | 0.8 | -0.31 | 3.64 | 1.11 | -0.07 | 0.23 |
| | | | (0.10) | | | (0.72) | (0.25) |
| Netherlands | 0.57 | 1.07 | -0.35 | 2.84 | 0.76 | 0.11 | -0.01 |
| | | | (0.10) | | | (0.63) | (0.97) |
| New Zealand | 0.51 | 1.86 | -0.09 | 5.61 | 1.62 | 0.01 | 0.53 |
| | | | (0.65) | | | (0.95) | (0.01) |
| Norway | 0.53 | 3.17 | 0.04 | 3.87 | 3.4 | -0.05 | -0.44 |
| | | | (0.82) | | | (0.81) | (0.02) |
| Spain | 0.54 | 1.06 | 0.30 | 3.38 | 1.59 | 0.09 | 0.34 |
| | | | (0.13) | | | (0.63) | (0.08) |
| Sweden | 0.64 | 1.48 | 0.07 | 3.60 | 1.49 | -0.12 | 0.21 |
| | | | (0.70) | | | (0.56) | (0.30) |
| UK | 0.62 | 0.99 | -0.31 | 4.10 | 1.19 | -0.02 | 0.25 |
| | | | (0.10) | | | (0.83) | (0.18) |
| US | 0.62 | 0.69 | -0.36 | 3.16 | 1.00 | 0.50 | -0.42 |
| | | | (0.05) | | | (0.01) | (0.03) |
| **Mean** | **0.56** | **1.34** | **-0.19** | **3.73** | **1.38** | **0.10** | **0.07** |

Notes: The table lists standard deviation and correlation statistics for the labour share shown in Figures 1 and 2. $P$-values are shown in parentheses. See Appendix A for data sources and sample period.

Table 3: Adjusted Labour Share Statistics

| | Labour Share | | | Adjusted Labour Share | | |
|---|---|---|---|---|---|---|
| | Mean | Std. Dev | Corr($s,y$) | Mean | Std. Dev. | Corr($s,y$) |
| Argentina | 0.36 | 5.02 | 0.56 | 0.43 | 5.60 | 0.54 |
| | | | (0.03) | | | (0.04) |
| Brazil | 0.48 | 2.38 | 0.03 | 0.54 | 2.88 | 0.20 |
| | | | (0.92) | | | (0.43) |
| Chile | 0.39 | 2.36 | -0.12 | 0.59 | 2.18 | -0.44 |
| | | | (0.54) | | | (0.13) |
| Colombia | 0.36 | 1.22 | -0.06 | 0.50 | 1.15 | -0.10 |
| | | | (0.88) | | | (0.67) |
| Costa Rica | 0.48 | 2.92 | -0.22 | 0.69 | 2.59 | -0.46 |
| | | | (0.26) | | | (0.03) |
| Czech Republic | 0.47 | 1.37 | 0.27 | 0.59 | 1.42 | 0.17 |
| | | | (0.30) | | | (0.33) |
| Egypt | 0.26 | 1.29 | 0.18 | 0.36 | 1.35 | 0.18 |
| | | | (0.58) | | | (0.59) |
| Hungary | 0.53 | 1.14 | 0.12 | 0.62 | 1.51 | -0.02 |
| | | | (0.67) | | | (0.95) |
| Korea | 0.49 | 1.36 | 0.44 | 0.65 | 1.45 | 0.32 |
| | | | (0.02) | | | (0.05) |
| Mexico | 0.33 | 3.72 | 0.60 | 0.46 | 3.34 | 0.58 |
| | | | (0.0) | | | (0.0) |
| Turkey | 0.27 | 6.40 | 0.25 | 0.42 | 6.22 | 0.15 |
| | | | (0.30) | | | (0.62) |
| **Mean** | **0.40** | **2.65** | **0.18** | **0.53** | **2.46** | **0.10** |

Note: Adj-1 calculates labour share as the ratio of labour compensation of the incorporated sector over value-added excluding the unincorporated sector. Adj-2 recalculates labour share using compensation per employees as a proxy for the labour income per self-employed person. See Appendix A for data sources and sample period for each country.

Table 4: Cyclical Variation in Self-Employment and Total Employment

| | Argentina | Brazil | Korea | Mexico | Turkey |
|---|---|---|---|---|---|
| $\rho(se, y)$ | 0.53 | 0.23 | -0.28 | 0.30 | -0.29 |
| $\rho(l, y)$ | 0.78 | 0.50 | 0.78 | 0.75 | 0.35 |

Notes: $\rho(x, y)$ is the correlation between two variables. $se$ denotes self-employment, whereas $l$ denotes total employment. The data cover the period after 1990. See Appendix A for data sources.

Table 5: Parameters

| Name | Symbol | Value | Explanation |
|---|---|---|---|
| Discount factor | $\beta$ | 0.98 | calibrated |
| Utility curvature | $\sigma$ | 5 | Neumeyer and Perri (2006) |
| Labour curvature | $\upsilon$ | 2.75 | calibrated |
| Labour weight | $\xi$ | varies | calibrated |
| Capital exponent | $\alpha$ | 0.43 | calibrated |
| Depreciation rate | $\delta$ | 0.02 | assumed |
| Wage bill paid in advance | $\theta$ | 1 or 0.66 | assumed |
| Bond holding cost | $\kappa$ | 0.001 | assumed |
| Capital adjustment cost | $\phi$ | varies | calibrated |
| Induced leverage | $\eta$ | 1.82 | calibrated |
| Net Foreign Debt / GDP | $\overline{\psi}$ | -0.42 | data |
| Persistence, $A_t$ | $\rho_A$ | 0.75 | estimated |
| Persistence, $R_t$ | $\rho_R$ | 0.63 | estimated |
| Correlation coef. | $\rho_{\epsilon_A,\epsilon_R}$ | -0.45 | estimated |
| Std. deviation, $A_t$ | $\sigma_{\epsilon_A}$ | 0.0134 | estimated |
| Std. deviation, $R_t$ | $\sigma_{\epsilon_R}$ | 0.0134 | estimated |

Table 6: Model Implications for Mexico

| | | | $\theta$=1 | | $\theta$=0.66 | |
|---|---|---|---|---|---|---|
| | **Data** | **RBC** | **Perfect Credit** | **Imperfect Credit** | **Perfect Credit** | **Imperfect Credit** |
| STANDARD DEVIATION | | | | | | |
| Output | 2.19 | 1.95 | 2.14 | 2.30 | 2.07 | 2.25 |
| Labour share | **3.58** | **0.0** | **1.68** | **2.62** | **1.12** | **2.13** |
| Net exports | 2.25 | 1.80 | 1.89 | 1.67 | 1.85 | 2.01 |
| STANDARD DEVIATION (RELATIVE) | | | | | | |
| Wage | 1.82 | 0.64 | 0.95 | 1.25 | 0.83 | 1.14 |
| Hours | 0.64 | 0.36 | 0.54 | 0.71 | 0.47 | 0.65 |
| Consumption | 1.35 | 0.56 | 0.69 | 1.08 | 0.65 | 1.28 |
| Investment | 3.45 | 3.45 | 3.45 | 3.45 | 3.45 | 3.45 |
| CORRELATION WITH OUTPUT | | | | | | |
| Labour Share | **0.44** | **0.0** | **0.52** | **0.68** | **0.48** | **0.68** |
| Interest Rate | -0.53 | -0.39 | -0.52 | -0.59 | -0.48 | -0.55 |
| Wage | 0.41 | 1.0 | 0.93 | 0.90 | 0.95 | 0.92 |
| Hours | 0.64 | 1.0 | 0.93 | 0.90 | 0.95 | 0.92 |
| Consumption | 0.89 | 0.87 | 0.86 | 0.92 | 0.86 | 0.91 |
| Investment | 0.94 | 0.30 | 0.46 | 0.91 | 0.41 | 0.88 |
| Net Exports | -0.65 | 0.43 | 0.24 | -0.56 | 0.30 | -0.58 |
| Lab. Share and R | -0.48 | 0.0 | -1.0 | -0.89 | -1.0 | -0.86 |

Note: Data period is 1987Q1-2008Q1. All variables are in logs (except net interest rate and net export) and HP-filtered using the smoothing parameter, 1600. See Appendix A for more information on the data. Investment adjustment cost parameter is set to match investment volatility. Net export is defined as exports minus imports over output. The last line represents the correlation between labour share and interest rates. The third and fourth columns represent the results from models with perfect and imperfect credits when the working capital parameter $\theta$ is equal to one. The last two columns assume a lower value for this parameter.

Table 7: Model Implications for Mexico and Canada

| | Mexico | | | Canada | | |
|---|---|---|---|---|---|---|
| | **Data** | **Baseline** | **Sluggish Labour** | **Data** | **Baseline** | **Sluggish Labour** |
| STANDARD DEVIATION | | | | | | |
| Output | 2.19 | 2.25 | 2.28 | 1.30 | 1.02 | 0.92 |
| Labour share | **3.58** | **2.13** | **1.67** | **1.05** | **0.19** | **0.31** |
| Net Exports | 2.25 | 2.01 | 2.25 | 0.88 | 0.21 | 0.27 |
| STANDARD DEVIATION (RELATIVE) | | | | | | |
| Wage | 1.82 | 1.10 | 1.14 | 0.64 | 0.49 | 0.40 |
| Hours | 0.64 | 0.65 | 0.65 | 0.65 | 0.49 | 0.40 |
| Consumption | 1.35 | 1.28 | 1.22 | 0.72 | 0.44 | 0.37 |
| Investment | 3.45 | 3.45 | 3.45 | 2.55 | 2.55 | 2.55 |
| CORRELATION WITH OUTPUT | | | | | | |
| Labour Share | **0.42** | **0.68** | **0.53** | **-0.62** | **-0.19** | **-0.73** |
| Interest Rate | -0.45 | -0.55 | -0.49 | 0.33 | 0.25 | 0.25 |
| Wage | 0.41 | 0.92 | 0.92 | -0.20 | 0.99 | 0.95 |
| Hours | 0.64 | 0.92 | 0.92 | 0.81 | 0.99 | 0.95 |
| Consumption | 0.89 | 0.91 | 0.83 | 0.69 | 0.99 | 0.95 |
| Investment | 0.94 | 0.88 | 0.72 | 0.72 | 0.96 | 0.95 |
| Net Exports | -0.65 | -0.58 | -0.30 | 0.07 | 0.55 | 0.68 |
| Labour Share and R | -0.48 | -0.86 | -0.89 | -0.15 | -0.94 | -0.12 |

Notes: The baseline model is the one with imperfect credit and $\theta = 0.66$. The third and sixth columns add adjustment cost on labour to the baseline model. For more information, see Table 6.

## A Data Sources

**Compensation of Employees, Mixed Income and GDP:** The data come from the UN and the OECD. They are compatible with the 1993 System of National Accounts. For a detailed source description for each country, see Table A1.

**Interest Rates:** The short-term cost of borrowing is obtained from IFS for emerging markets. They are mostly money market rates, except for Egypt, Hungary, Israel and Peru. I have three-month treasury bill rates for Egypt, Hungary and Israel, and deposit rates (for maturities less than a year) for Peru. For robustness, I have short-term lending rates for some emerging economies as well. The short-term rates for developed markets come from the OECD.

**GDP deflator:** The data are of the same source as the interest rates for each country.

**EMBI rates:** The data on EMBI spreads for emerging economies come from the Uribe and Yue (2006) data set. For the recent global financial crisis, I have the data from the JP-Morgan EMBI database.

**Self-employment ratios:** The sources are the OECD for Mexico, Korea, and Turkey, and the ILO for the rest of the countries.

**Informal employment:** Informal employment refers to the self-employed in their own informal sector enterprises, contributing family workers (unpaid), members of informal producers' co-operatives (not established as legal entities), employees holding informal jobs (i.e., jobs not subject to national labour legislation, income taxation, social protection or entitlement to certain employment benefits, such as sick leave), and own-account workers engaged in the production of goods exclusively for own final use by their household. Therefore, informal employment covers employment in the informal sector as well as informal employment in the formal sector (informal jobs in the formal enterprises). The source is ILO KILM 8 Indicators.

**Mexican quarterly data:** The quarterly labour share for Mexico comes from the manufacturing sector, covering the period between 1987Q1-2008Q1. The source is the OECD. Wages represent hourly earnings in manufacturing from OECD monthly economic indicators (MEI). Hours are the proxy for the total hours worked in the total economy. They are constructed as hours per worker in manufacturing multiplied by the total civilian employment. Total hours worked and employment come from INEGI (industrial survey in manufacturing). Total employment is from Neumeyer and Perri (2005) for the period between 1987Q1 and 2001Q1. I then extend the data using the ILO labour statistics database until 2008Q1. The source for interest rates, GDP and the GDP deflator is IFS. Interest rates are the average cost of borrowing in the total economy. I also use JP-Morgan EMBI+ data from Uribe and Yue (2006). Other variables for Mexico, such as consumption, net export and investment, come from the OECD quarterly database.

**Canadian quarterly data:**
Data on labour income share and employment are from the OECD, and cover the whole economy. For wages, I have quarterly data for the overall economy from the ILO. I take the same data period as in the case for Mexico (1987Q1-2008Q1). Interest rates are the short-term treasury bills from

OECD. All other variables, including GDP, the GDP deflator, consumption, investment and net exports, are taken from the OECD quarterly database.

## B Construction of Solow Residuals and Real Interest Rates for Mexico

I calculate Solow residuals using Mexican GDP from the OECD: $lnA_t = ln(y_t) - \alpha ln(k_t) - (1 - \alpha)ln(l_t)$. The capital exponent is set to match the average labour share (see below) in Mexico. The employment series comes from Neumeyer and Perri (2005) and I extend it to 2008Q4 using series from the ILO. In order to find total labour input used in production, I calculate total hours by the given employment series and hours worked in manufacturing from the OECD for Mexico. Capital stock series are constructed using the investment perpetual method. Particularly, I set the depreciation rate, $\delta = 0.02$ and use the balanced growth path equation, $\frac{(\delta+\gamma)k}{y} = \frac{i}{y}$. Assuming that there is a constant growth rate on the path for the first ten quarters, I find the approximate initial capital stock. Then, I extend the capital stock data using investment series from the OECD. Detrended Solow residuals suggest an AR(1) coefficient of 0.75 and a standard deviation of 1.34% of shocks to TFP.

For interest rates, EMBI rates are constructed using JP-Morgan EMBI+ spread data from Uribe and Yue (2006). Since these bonds are denominated in U.S. dollars, real yields are calculated using U.S. inflation as discussed in section 2. For Mexican T-bill rates, I use the Mexican GDP deflator to obtain real returns. Since the model does not take into account inflation, I subtract the next-period inflation from nominal interest rates to find the (ex-post) real interest rate in Mexico. Note that using different types of expected inflation such as an average of past inflation rates still suggests similar volatility in interest rates. However, using current and/or past inflation in an environment with highly volatile inflation might be fallacious.[43]

## C Calibration for Canada

The discount factor is calibrated to 0.99, which suggests a 4% annualized interest rate at the steady state for Canada. The labour curvature parameter is set to 2 to match a Frisch elasticity of labour of 1, implying an elasticity of labour higher than in Mexico. This value is within the range of estimates used in the literature for developed markets. The capital exponent is set to be equal to 0.40 following the literature on business cycles. The elasticity of the credit-income criterion to interest rates is assumed to be equal to 0.75, less than half of the value calibrated for Mexico. By doing this, I assume that Canada has better financial institutions; i.e, a less-imperfect financial industry. The net foreign asset ratio at the steady state is calculated using the data on external asset positions from Lane and Milesi-Ferretti (2007). AR(1) coefficients for productivity and interest rates are found to be 0.78 and 0.70, respectively. Standard deviations of shocks to these series are 0.7% and 0.25%, respectively. The correlation coefficient between these shocks is estimated to be 0.20. The rest of the parameters are the same as those for Mexico.

[43] I also use the trend portion of the current and/or past inflation and observe that the results for the estimated shock parameters do not change much.

Table A1: Data Sources

| | Period | Compensation & GDP (VA) | Short-term Interest Rates |
|---|---|---|---|
| **Emerging Markets** | | | |
| Argentina | 1993-2007 | UN | IFS |
| Brazil | 1992-2007 | UN | IFS |
| Chile | 1981-2007 | UN | IFS |
| Colombia | 1992-2007 | UN | IFS |
| Costa Rica | 1982-2007 | UN | IFS |
| Czech Rep. | 1992-2008 | OECD | IFS |
| Egypt | 1996-2006 | UN | IFS |
| Hungary | 1995-2008 | OECD | IFS |
| India | 1981-2002 | UN | IFS |
| Israel | 1995-2007 | UN | IFS |
| Korea | 1981-2008 | OECD | IFS |
| Mexico | 1981-2008 | OECD | IFS |
| Peru | 1986-2006 | UN | IFS |
| Philippines | 1992-2007 | UN | IFS |
| Poland | 1991-2008 | OECD | IFS |
| Russia | 1995-2008 | UN | IFS |
| South Afr. | 1981-2008 | UN | IFS |
| Turkey | 1987-2006 | UN | IFS |
| **Developed Markets** | | | |
| Australia | 1981-2008 | OECD | OECD |
| Austria | 1990-2008 | OECD | OECD |
| Canada | 1981-2008 | OECD | OECD |
| Denmark | 1987-2008 | OECD | OECD |
| Finland | 1987-2008 | OECD | OECD |
| France | 1981-2008 | OECD | OECD |
| Germany | 1981-2008 | OECD | OECD |
| Greece | 1981-2008 | OECD | IFS |
| Iceland | 1988-2008 | OECD | OECD |
| Ireland | 1984-2008 | OECD | OECD |
| Italy | 1981-2008 | OECD | OECD |
| Netherlands | 1986-2008 | OECD | OECD |
| New Zealand | 1981-2008 | OECD | OECD |
| Norway | 1981-2008 | OECD | OECD |
| Spain | 1981-2008 | OECD | OECD |
| Sweden | 1982-2008 | OECD | OECD |
| United Kingdom | 1981-2008 | OECD | OECD |
| United States | 1981-2008 | OECD | OECD |